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TESTS SCHEDULED ON NASA CLEAR AIR TURBULENCE WARNING INSTRUMENT

Scientists from NASA's Ames Research Center, Mountain View, Calif., and the National Oceanic and Atmospheric Administration's (NOAA) Environmental Research Laboratory in Boulder, Colo., will begin flight testing this month on an instrument concept designed to give pilots several minutes' warning of an impending encounter with clear air turbulence.

The atmospheric phenomena known as CAT, for clear air turbulence, has been a problem since the beginning of the jet age. These naturally occurring, tempestuous air currents can unexpectedly add bumps to an aircraft's smooth ride even though the sky is cloudless.

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As its name implies, CAT occurs in clear air. Thus the pilot cannot see it and has no indication of when or where it will be encountered. Needed is a simple, reliable cockpit instrument to alert pilots as they approach CAT.

The CAT detector to be tested uses an infrared (IR) water vapor radiometer to measure the amount of moisture present in the atmosphere.

NOAA scientist Dr. Peter Kuhn, an experimenter on NASA's Gerard P. Kuiper Observatory (a C-141 aircraft equipped with a large telescope for astronomy research) noticed that extreme turbulence encountered by the aircraft was often accompanied by variations in the amount of water vapor in the atmosphere as measured by his IR radiometer.

At that time, the instrument was designed to measure the amount of water vapor in the atmosphere above the aircraft to define atmospheric conditions in the telescope's field of view.

Dr. Kuhn, intrigued with the idea that it might be possible to "see" areas of turbulence ahead of an aircraft, suggested mounting another IR radiometer in the aircraft, this time aimed forward.

The forward-looking system successfully detected turbulence. With the help of a simple program in the computer aboard the research aircraft, CAT occurrences were being predicted from two-and-one-half to five-and-one-half minutes before actual encounter.

These results were encouraging because clear air turbulence could be detected by identifying water vapor discontinuities in the air ahead of an airplane.

But there were still problems. Since the mission of the C-141 aircraft requires flying highly accurate flight paths through the cold stratosphere, there was no opportunity to purposely search out CAT areas and to fly into them from different directions at various altitudes. Moreover, the researchers wanted to experiment with filters which could change the "look" distance to the encounter and provide information on the depth of the disturbance. They also wanted more time to "fine tune" the instrument for optimum results and to minimize the false alarm rate for such a system.

Accordingly, NASA and NOAA set up a joint program, making plans to conduct exhaustive tests on the device using a NASA Lear Jet Research Aircraft.

Research flights with the CAT warning device aboard a Lear jet will begin in January in the skies over Colorado. The aircraft will be based at Stapleton International Airport at Denver for periods of up to a week.

Researchers hope the flight program will lead to development of a low cost system which can be installed in any aircraft. It would operate unattended and require minimum maintenance service. If it is found feasible it will produce a cockpit visual alert from four to 15 minutes in advance of a CAT encounter.

Such an instrument could enhance safety and comfort of flight by giving pilots warning of imminent turbulence encounters, allowing time for the flight and cabin crews to prepare for turbulence or possibly to avoid turbulent areas.

NASA's interest in CAT detection began in the late 1960s with investigation of a laser Doppler detection concept.